

What is claimed is:

1. A secondary air supply control apparatus for an internal combustion engine, comprising:

a catalyst for purifying an exhaust gas, the catalyst being disposed in an exhaust passage of an internal combustion engine and;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit for detecting an air-fuel ratio in the exhaust gas, the air-fuel ratio detection unit being disposed in the exhaust passage between the catalyst and a secondary air supply hole and for detecting an air-fuel ratio in the exhaust gas; and

an air-fuel ratio feedback control unit for executing an air-fuel ratio feedback control to cause the air-fuel ratio detected by the air-fuel ratio detection unit to become coincident with a previously set target air-fuel ratio when a specified air-fuel ratio feedback control condition is established during supply of the secondary air provided by the secondary air supply mechanism,.

2. A secondary air supply control apparatus of an internal combustion engine according to claim 1, wherein the air-fuel ratio feedback control unit sets an initial value of the target air-fuel ratio at a start time of execution of the air-fuel ratio feedback control to the air-fuel ratio detected by the air-fuel ratio detection unit at this time,

and gradually changes the target air-fuel ratio from the initial value to a specified air-fuel ratio.

3. A secondary air supply control apparatus of an internal combustion engine according to claim 1, wherein the air-fuel ratio feedback control unit sets an initial value of the target air-fuel ratio at a start time of execution of the air-fuel ratio feedback control to a minimum air-fuel ratio detected in a specified period by the air-fuel ratio detection unit from a supply start of the secondary air, and gradually changes the target air-fuel ratio from the initial value to a specified air-fuel ratio.

4. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst for purifying an exhaust gas, the catalyst being disposed in an exhaust passage of an internal combustion engine and;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit for detecting an air-fuel ratio in the exhaust gas, the air-fuel ratio detection unit being disposed in the exhaust passage between the catalyst and a secondary air supply hole and;

an air-fuel ratio estimation unit for estimating an air-fuel ratio supplied to the internal combustion engine on the basis of various operation parameters; and

a target air-fuel ratio setting unit for setting an

initial value of a target air-fuel ratio for the air-fuel ratio detected by the air-fuel ratio detection unit in an air-fuel ratio feedback control immediately after an end of supply of the secondary air provided by the secondary air supply mechanism to an air-fuel ratio estimated by the air-fuel ratio estimation unit at this time, and for gradually changing the target air-fuel ratio the initial value to a stoichiometric air-fuel ratio.

5. A secondary air supply control apparatus of an internal combustion engine according to claim 4, wherein the various operation parameters include at least one of an engine rotation speed, a load, an intake air amount, a cooling water temperature and an after-starting elapsed time.

6. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit for detecting an air-fuel ratio in the exhaust gas, the air-fuel ratio detection unit being disposed in the exhaust passage between the catalyst and a secondary air supply hole; and

a target air-fuel ratio setting unit for setting an initial value of a target air-fuel ratio for the air-fuel ratio detected by the air-fuel ratio detection unit in an

air-fuel ratio feedback control immediately after an end of supply of the secondary air provided by the secondary air supply mechanism to an air-fuel ratio detected by the air-fuel ratio detection unit after a specified time has passed since the air-fuel ratio feedback control was suspended at this time, and for gradually changing the target air-fuel ratio from the initial value to a stoichiometric air-fuel ratio.

7. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst; and

a fuel supply control unit for inhibiting an increase in an amount of fuel injection to the internal combustion engine during supply of the secondary air provided by the secondary air supply mechanism.

8. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit for detecting an air-fuel ratio in the exhaust gas, the air-fuel ratio

detection unit being disposed in the exhaust passage between the catalyst and a secondary air supply hole ; and

a fuel supply control unit for setting, when a fuel injection amount to the internal combustion engine is increased to maintain the air-fuel ratio detected by the air-fuel ratio detection unit during supply of the secondary air provided by the secondary air supply mechanism, a specified delay time for the increase in the amount from a supply start of the secondary air.

9. A secondary air supply control apparatus of an internal combustion engine according to claim 8, wherein the fuel supply control unit gradually change the fuel injection amount until the increase in the amount is attained.

10. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit for detecting an air-fuel ratio in the exhaust gas , the air - fuel ratio detection unit disposed in the exhaust passage between the catalyst and a secondary air supply hole ; and

an air-fuel ratio arithmetic unit for calculating, as the air-fuel ratio, an average value of output values detected by the air-fuel ratio detection unit during supply of the

secondary air provided by the secondary air supply mechanism.

11. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit disposed in the exhaust passage between the catalyst and a secondary air supply hole and for detecting an air-fuel ratio in the exhaust gas; and

an air-fuel ratio arithmetic unit for calculating, as the air-fuel ratio, a minimum value of output values detected by the air-fuel ratio detection unit during supply of the secondary air provided by the secondary air supply mechanism.

12. A secondary air supply control apparatus of an internal combustion engine, comprising:

a catalyst disposed in an exhaust passage of an internal combustion engine and for purifying an exhaust gas;

a secondary air supply mechanism for supplying secondary air into the exhaust passage at an upstream side of the catalyst;

an air-fuel ratio detection unit disposed in the exhaust passage at the upstream side of the catalyst and at a downstream side of a secondary air supply hole and for detecting an air-fuel ratio in the exhaust gas;

a crank angle detection unit for detecting a crank angle of the internal combustion engine; and

an air-fuel ratio arithmetic unit for calculating, as the air-fuel ratio, an output value detected by the air-fuel ratio detection unit at a specified crank angle during supply of the secondary air provided by the secondary air supply mechanism.

13. A secondary air supply control apparatus of an internal combustion engine according to any one of claims 10 to 12, further comprising an air-fuel ratio feedback control unit for executing an air-fuel ratio feedback control so that when a specified air-fuel ratio feedback control condition is established during supply of the secondary air provided by the secondary air supply mechanism, the air-fuel ratio calculated by the air-fuel ratio arithmetic unit becomes coincident with a previously set target air-fuel ratio.

14. A secondary air supply control apparatus of an internal combustion engine according to claim 13, wherein the air-fuel ratio feedback control unit executes the air-fuel ratio feedback control in a period when the supply of the secondary air provided by the secondary air supply mechanism has an influence.